



Fuel Efficient ground vehicle Demonstrator (FED) Vision

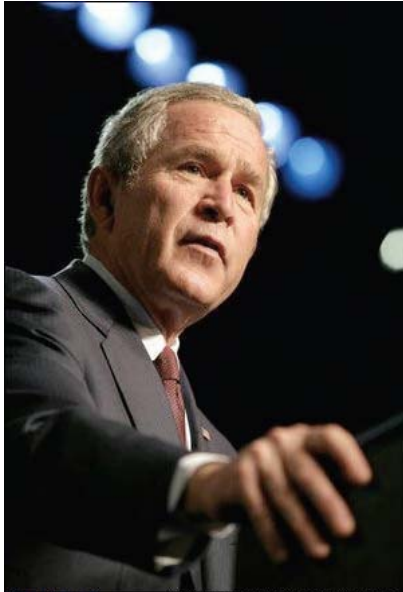


TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.

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More Photos White House photo by Eric Draper

“For too long our nation has been dependent on foreign oil. And this dependence leaves us more vulnerable to hostile regimes and to terrorists – who could cause huge disruptions of oil shipments, raise the price of oil and go great harm to our economy. ...It is in our vital interest to diversity America’s energy supply – **and the way forward is through technology.”**

State of the Union Address, 23 January 2007

“As we work to expand trade and investment, we’ve also got to address the challenges of energy security and global climate change. We need to harness the power of technology to help nations meet their growing energy needs in ways that improve the environment.”

Speech at the Asia-Pacific Economic Cooperation Business Summit, 7 August 2007

U.S. Marine Corps Maj. Gen. Richard Zilmer, Al-Anbar Commander, submitted an **urgent request for renewable energy systems**, due to the vulnerability of American supply lines to insurgent attack by ambush or roadside bombs. The request said **“reducing the military’s dependence on fuel for power generation could reduce the number of road-bound convoys.”** ...’Without this solution [renewable energy systems], personnel loss rates are likely to continue at their current rate. Continued casualty accumulation exhibits potential to jeopardize mission success...’”

Defense News, August 2006



- Increase force protection
 - Fewer fuel convoys means fewer people and systems in harm's way
- Increase sustainability
 - Operate for longer / go farther without resupply
 - Reduce O&S costs
 - Crude oil closed at \$96.37/Bbl on 11-7-07; DoD standard (refined) price is additional \$25/Bbl
 - Free up manpower and equipment
- Reduce dependency on foreign oil
 - Reduce revenue flow to unfriendly / unstable nations



- DoD's energy strategy emphasizes demand reduction while exploring alternative sources
- DoD energy efforts will focus on
 - Increase operational capability
 - Reduce costs
 - Help the nation reduce its dependence on oil

Fuel Efficient Demonstrator Project

The Fuel Efficiency Demonstrator (FED) Program was initiated by OSD to address energy conservation needs highlighted by the Defense Science Board: Energy Security Task Force. The overarching goal of the program is to improve military vehicle technology to reduce fuel consumption on the battlefield, and reduce our dependence on oil.



- ✓ **Form a team comprised of Government and Industry subject matter experts.**
 - ✓ Identify and engage key Industry subject matter experts who have demonstrated expertise in novel and innovative design, advanced automotive engineering, prototyping and manufacturing expertise in military, specialty and performance vehicles (e.g., motor sports).
- ✓ **Survey Government and Industry to identify and harvest opportunities in fuel efficient technologies, lightweight components, and fuel efficient vehicles**
- ✓ **Leverage Government and Industry fuel efficiency and lightweight materials initiatives:**
 - ✓ Army Hybrid Electric Vehicle (HEV) Assessment and Experimentation S&T Effort (FY06) in Support of Joint Light Tactical Vehicle (JLTV)
 - ✓ Army Technology Objective (ATO) S&T Effort in HEV Components for FCS
 - ✓ Army S&T Effort in Tactical Wheeled Vehicle Survivability and Vehicle Armor Technology ATO
 - ✓ Army/USMC/Navy Efforts Supporting JLTV
- ✓ **Leverage Government and Industry Modeling and Simulation (M&S) capabilities to build the vehicle virtually to predict performance, set objectives, refine the concept and establish test criteria**
- ✓ **Potentially demonstrate achievement of fuel efficiency in hardware with an advanced, fuel efficient, lightweight tactical vehicle demonstrator**
- ✓ **Baseline performance against the M1114 Up-armored HMMWV capabilities (mobility and survivability) to provide battlefield reality**
- ✓ **Quantify O&S cost impacts**



Potential Technologies/Techniques to Increase Vehicle Fuel Efficiency and/or Reduce Weight



•Propulsion Improvements/Technology

- Opposed Piston Opposed Cylinder (OPOC) Engine
- Direct Injection, Non-Emissions Certified Engine
- Engine Turbocharger/Waste Gate Control Optimization
- Open Chamber Engine Design with Modifications to Pistons, Connecting Rods and Injection Pump
- Electrification of Vehicle Thermal Management System
- Variable Speed Mechanical Fan Drive
- Variable Displacement Engine

•Driveline Improvements/Technology

- Parallel Hybrid Electric System
- Series Hybrid Electric System
- Integrated Starter Generator/Alternator
- Continuously Variable Mechanical Transmission
- Infinitely Variable Transmission (series hydraulic drive)
- Braking Regeneration
- 2 Wheel Drive Mode
- Tire Wheel (TWEEL)
- Low Rolling Resistance Tires
- Drive by Wire Steering

•Reduced Weight Structure/Frame

- Advanced Materials: Composites, Titanium, Aluminum, Alloys
- Space Frame Configurations
- Hydroformed Frame

•Lightweight Vehicle Components

- Aluminum/Magnesium Components (engine block, housings, etc.)
- Composite Interior Components (seats, dash, etc.)
- Composite Automotive Components(wheels, drive shaft, etc)
- Composite Ceramic Brake Rotors

•Integration

- Computer Aided Design Optimization
- Integral structure/armor
- Improved Aerodynamics



- **The FED program is innovative on a variety of levels**
 - Technology selection, integration and transition
 - Government Personnel development
- **Will help to document the process of how to build in fuel economy.**
- **Government engineers will work side by side with the innovators and industry experts exposing them to novel and innovative design, advanced automotive engineering, and systems engineering practices and methodologies – the expected by product of this experience is that they will approach a problem differently.**
- **Fuel efficient technologies selected by the working group using the “Monster Garage” process are candidates to be transitioned to other wheeled vehicles.**